

## CHAPTER 5

### REGULATORY CONCERNS

#### A. INTRODUCTION

Drinking water quality in Illinois is administered by the Illinois Environmental Protection Agency (IEPA). They are responsible for locally enforcing the Federal laws governing drinking water including the Safe Drinking Water Act. This Act was reauthorized in 1996, and at that time, many significant changes were made to the existing legislation. Many of these changes provided for entirely new "rule packages" which are being finalized and enforced over the following several years. Some of these new issues, as well as existing regulatory issues impact CIWC and are discussed in this chapter.

#### B. EXISTING REGULATIONS

Regulations already in place, which are of concern to the CIWC include those dealing with nitrates and synthetic organic chemicals. Additionally, several categories of regulations have been recently finalized or are due out in the near future, which include turbidity, disinfection by-products, and filter backwash recycle to name a few. All of these will likely impact the future of this treatment plant, and they are discussed individually below.

##### 1. Nitrates

Nitrates are a common compound associated with many uses. Nitrates found in the Lake Vermilion watershed are the result of agricultural runoff. A very large majority of the watershed is actively farmed, which therefore contributes significantly to the problem. Nitrates in water are regulated by the EPA due to their effects when ingested in large quantities. Nitrates have been linked to methemoglobinemia or blue baby syndrome, which is especially troublesome to small children, causing death in severe cases.

The EPA has set the maximum contaminant level for nitrates at 10 mg/l measured as N. Current treatment practices at the CIWC plant do not provide much, if any, treatment for removal of nitrates. Typically, raw water nitrate levels are below the 10 mg/l standard; however, at times of high rainfall, the raw water nitrate levels can become quite elevated and remain above 10 mg/l as N for relatively long periods. This is especially true for a period from early spring, prior to planting, until a robust crop is established in late June or early July. When this occurs, the Water Company is in violation of the maximum contaminant levels set by the EPA. Violations have occurred for periods of up to 186 days with levels as high as 15.6 mg/l. Although, these levels, in and of themselves are not harmful to the general population, they do pose a threat to babies and young children.

The Water Company entered letter of commitment agreement with the Illinois Environmental Protection Agency in 1992 to rectify this problem.

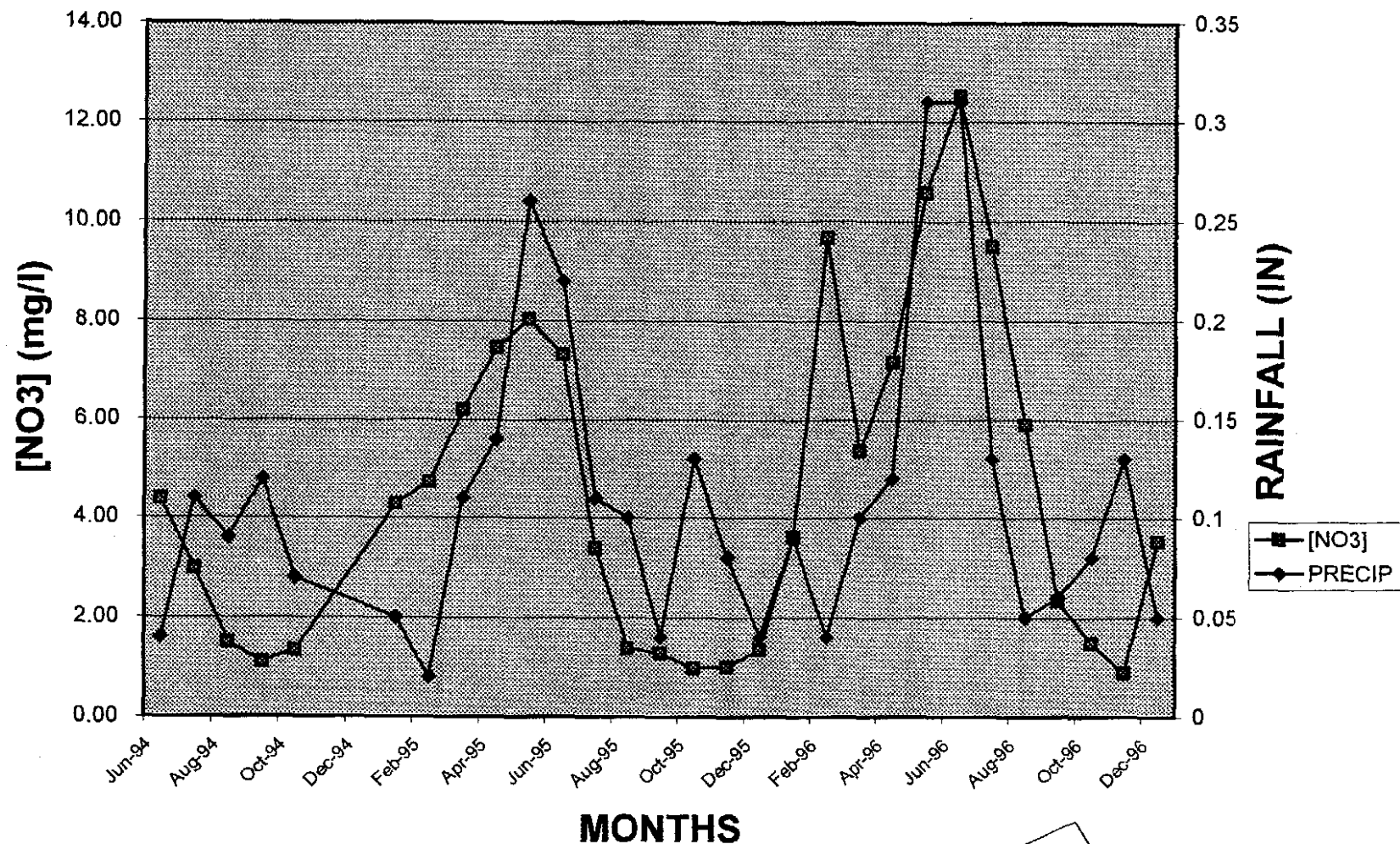
The nitrate levels in the raw water are heavily dependent on rainfall and season. A high correlation between rainfall and elevated nitrate levels exists especially in the period from April to late June or July. Typically, there is a 24 to 48 hour lag between the rain event and elevated nitrate levels during these months. This is shown in Exhibit 5-1.

Peak nitrate concentrations in the raw water are also highly correlated with peaking total solids constituents, which also is consistent with the correlation with rainfall events. This is shown in Exhibit 5-2.

History indicates that the nitrate levels within the watershed will continue to be elevated for certain periods of the year. Therefore, long term treatment capabilities will be required to address the problem.

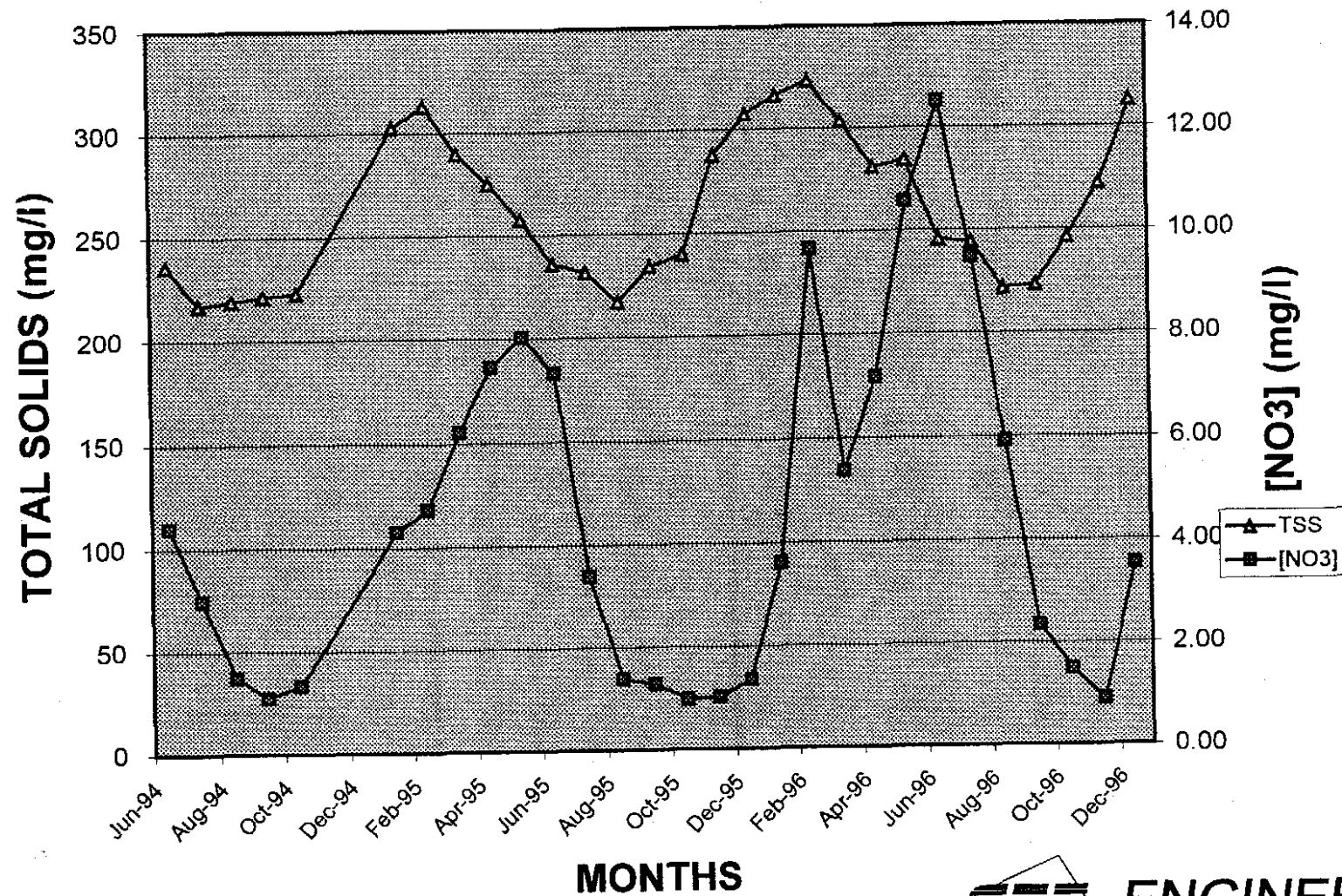
Future regulations on nitrates are not likely to change significantly.

## EXHIBIT 5-1 NITRATE AND RAINFALL CORRELATION




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## EXHIBIT 5-2 TOTAL SOLIDS AND NITRATE CORRELATION




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## **2. Synthetic Organic Chemicals**

Like nitrates, synthetic organic chemicals (SOC's) make their way to Lake Vermilion from mostly agricultural sources. SOC's have occasionally been detected in the raw water but never at levels which trigger a violation. These chemicals are agricultural products such as atrazine, simazine and cyanazine, which are used as herbicides and pesticides in the watershed. Although these do not pose an immediate problem for the Water Company, they are consistently monitored.

To treat elevated levels of SOC's, CTE has evaluated and recommended that CIWC construct a new powdered activated carbon slurry system, which will provide them with three feed points from which they can apply the slurry. The cost of the new PAC system is included in Chapter 8 of this report with the cost analyses for each of the alternatives evaluated.

### **A. NEW REGULATIONS**

#### **1. Disinfectants/Disinfection Byproducts**

The Stage 1 Disinfectants/Disinfection Byproducts Rule (D/DBPR) was published by the USEPA in December 1998. The main goal of Stage 1 D/DBPR is to reduce disinfectant demand and total disinfectant concentration, which in turn will reduce the concentration of potentially harmful disinfection byproducts that are formed by the reaction of chlorine with organic materials. The byproducts of concern include total trihalomethanes, total haloacetic acids, chlorite and bromate. The Stage 1 D/DBPR sets the maximum contaminant levels (MCL) for total trihalomethanes (TTHMs) and the sum of five haloacetic acids (HAA5) at 80 and 60 µg/l, respectively. The Stage 1 D/DBPR was effective as of February 1999, and large surface water systems (systems serving 10,000 or more people) must be in compliance by December 16, 2001.

Under Stage 2 of this rule, which may be promulgated as early as May 2002, the maximum contaminant levels for TTHMs and HAA5 may be reduced to 40 and 30 µg/l, respectively, with compliance anticipated by the year 2005.

This rule was promulgated via the "reg/neg" process, which allowed significant input from stakeholders and also allowed for risk/benefit and economic analysis. It is possible that the actual Stage 2 regulations will be significantly different than the 40 µg/l now being considered because of the reg/neg process and the high costs that would be required to meet the 40 µg/l standard.

The Water Company typically has trihalomethane (THM) levels, between 40 and 80 µg/l based on its current treatment process and disinfection with chlorine gas. Therefore, the potential exists for D/DBP levels in excess of the Stage 2 regulations if there are no changes made to the treatment process.

Generally D/DBP levels can be lowered in one of two ways. First, through removal of D/DBP precursor compounds (natural organic matter) using activated carbon or some membrane technologies. Secondly, by changing the points of chlorine application or changing the disinfectant used. Either, or both, of these methods may be required if the Stage 2 regulations are promulgated.

The available options for different disinfectants include ozone, ultraviolet radiation (UV) and chloramines. Each of these has different advantages and disadvantages. For instance, ozone is a very good oxidizer, which will effectively disinfect but provides no disinfectant residual to protect the water once it leaves the plant and enters the distribution system. Ozone systems are also quite expensive to construct and operate. UV has been used for many years as a wastewater disinfectant, however, this technology is relatively untested in the potable water market. UV, like ozone, provides no disinfectant residual. The use of chloramines is similar to the use of chlorine. They do provide a disinfectant residual. The Water Company formerly utilized chloramines as their primary disinfectant before the existing treatment plant was constructed.

## **2. Turbidity**

Turbidity is a measure of the dispersion of light through a liquid. Turbidity is also an indicator of the amount of particles in a fluid. The Interim Enhanced Surface Water Treatment Rule (IESWTR), which was finalized in December 1998, requires combined filter effluent turbidities to be less than 0.3 nephelometric turbidity units (ntu) in 95 percent of samples taken and less than 1 ntu in 100 percent of samples taken. This rule was effective as of February 1999. Systems are required to establish a disinfection benchmark by March 2000 and must meet monitoring and reporting requirements for turbidity by December 2001.

The Water Company may have trouble meeting the lower standard especially during low temperature, high raw water turbidity events. Currently, low temperature water creates a situation where good quality floc formation is difficult. To gain better operational control of the high turbidity problem, CTE has evaluated and recommended changing the six existing filters from declining rate to constant rate variable level filters. The cost of these improvements are included in the cost analyses found in Chapter 8 for each of the alternatives. Another possible option would be to utilize a pre-sedimentation basin to reduce the influent turbidity to the clarifiers. Once the regulations governing backwash water recycle go into effect, the basin currently used to reclaim the backwash water could be utilized for this purpose. Other possible presedimentation basin locations include the current sludge lagoon site if alternative sludge disposal options can be accommodated or an existing strip of land at the treatment plant site.

## **3. Filter Backwash Recycle**

The existing treatment plant practices recycling of filter backwash water. In other words, filter backwash waste is sent back to the head of the treatment plant to be retreated rather than "wasted." This practice was highly encouraged by the EPA from the 1970s to the 1990s due to the fact that filter backwash water can account for up to 10 percent of a plant's flow. This practice attempts to conserve valuable resources of water and electricity. However, recent events have demonstrated that the recycle practice may be undesirable from a water quality standpoint, as it reintroduces to the raw water constituents in a concentrated form, which have already been removed.

The Reauthorization of the Safe Drinking Water Act in 1996 specifically addresses this issue and requires new regulations on this subject by the year 2000. Conversations with several State Drinking Water Administrators, including Illinois, indicate that the backwash recycle regulations will be amended to limit the allowable percentage of backwash water that can be recycled and to require either some type of pretreatment of the recycled backwash water prior to reintroduction or discharge to a suitable disposal site (i.e. sanitary sewer).

The envisioned new regulations would require the Water Company to change its current recycle practice. Since 10 percent of total capacity going to waste represents a significant capacity loss and disposal cost, investigation of a treatment alternative such as sedimentation with or without coagulation, and/or some type of disinfection or a small microfiltration plant may be necessary once the future regulations are more clearly defined.

## CHAPTER 6

### EXISTING TREATMENT FACILITIES

#### A. DESCRIPTION OF UNIT PROCESSES

The existing CIWC treatment facility is a conventional facility utilizing the unit processes of chemical addition, softening, clarification, recarbonation, filtration and disinfection. The plant has a hydraulic capacity of approximately 14 mgd. Exhibit 6-1 is a site plan of the existing facilities.

Water from the North Fork of the Vermilion River is screened and pumped to the four circular reactor/clarifiers. Here lime and ferric chloride are added and mixed with the raw water and then allowed to settle. The lime raises the pH of the water which helps form a precipitate in the solution.

This removes the calcium and magnesium hardness from the solution in a solid state, thereby softening the water. The ferric chloride acts to agglomerate these particles into a floc which will settle by gravity in the clarifiers and can then be removed as sludge. The clarifiers can be operated in a series of two banks of two reactors each (typically spring, summer and fall operation) or in parallel as four separate reactors (only in winter).

There are typically three modes of operation at the plant:

- 1) Conventional
- 2) Herbicide and taste & odor removal
- 3) Treatment of high turbidity waters in winter and spring

The first mode includes ferric chloride application at the intake, two primary clarifiers used for lime softening, and two secondary clarifiers used as back-up clarifiers.

The second mode is similar to the first except that powdered activated carbon is added at the intake, and the two primary clarifiers are utilized only for contact time; the secondary clarifiers then provide lime softening and settling.

The last mode includes the application of ferric chloride at the intake and the utilization of all four clarifiers in parallel. This mode makes it difficult for personnel to properly split lime between the basins. This mode is required due the difficulty posed in removing sludge from the basins quickly enough.

From the clarifiers, the water is recarbonated by bubbling carbon dioxide through it in order to stabilize the water through pH adjustment.

After recarbonation, the water is sent to the conventional rapid sand filters to further remove any particulate contamination. The filters are comprised of six individual filter units, each equipped with air and surface wash capabilities to aid in cleaning. Water flows through a multimedia bed of sand, garnet and anthracite by gravity and is collected by an underdrain system for transport to the reservoir for disinfection, storage and high service pumping.

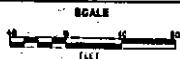


The filters are rated at up to 5 gallons per minute per square foot of surface area but are typically not run at those high rates.

After the water is filtered, it is disinfected using chlorine and then stored in the reservoir until it is pumped to distribution through the high service pumping system.

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DESIGNER CAI  
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 DATE AUGUST, 1989



CONSUMERS ILLINOIS WATER COMPANY  
DANVILLE (VERMILION) WATER TREATMENT PLANT  
IMPROVEMENT PROJECT



PLANT SITE PLAN  
PROPOSED ION EXCHANGE OR REVERSE  
OSMOSIS SYSTEM

SHEET EXHIBIT 7-11  
OF 3  
CITE PROJECT NO. 401B4

## **B. TREATMENT DIFFICULTIES**

The following situations cause the operating personnel some difficulty in treating the raw water through the existing plant.

1. High flow, storm runoff in the spring with low alkalinity and hardness. There is not enough alkalinity and hardness for lime (only) softening to produce the desired hardness precipitates to weight the floc.
2. The Water Company has not had much success with polymer use either in coagulation or as a filter aid. They have tried anionic filter aid without much benefit and with shorter filter cycles resulting.
3. The daily plant load varies greatly in order to take advantage of off-peak power charges. This poses difficulty in operating with a sludge blanket in the clarifiers. When the load is increased, the sludge blanket expands (as expected) and may go over into the filters.
4. Storm events result in rapidly varying source water quality with increases in turbidity, SOC's, herbicides, and nitrates.
5. The clarifier upflow rate at design load (14 MGD) is 1.7 gpm/sf with two clarifiers in parallel. This is appropriate for lime softening but not for clarification alone. Per the 10 State Standards, the upflow rate shall not exceed 1.0 gpm/sf for units used for clarifiers and 1.75 gpm/sf for units used for softeners. Therefore, this eliminates the option of clarification without softening unless the four clarifiers are run in parallel.

## **C. OPERATIONAL CONSIDERATIONS TO EXPLORE**

### **1. Color**

- Start monitoring and recording the true color of the source water on a regular basis.
- It can be expected that the required ferric dose will be strongly influenced by the true color as well as by the turbidity. This has been shown to be true at many surface water softening plants. Monitoring the color will provide another measure of the required chemical dosage and allow the operator to make adjustments based on as much information as possible. In many cases, true color has proven to be a more accurate indicator of water quality than the other conventional parameters such as alkalinity and turbidity.

### **2. Magnesium as a Control Parameter**

- Use a consistent caustic alkalinity (i.e., 2P-T) in the clarifier as a control parameter for the lime feed during softening. This should be used by all shift operators, even if settled water turbidity might imply that a lesser dose could be used.

- This should result in more consistent magnesium reduction with the  $Mg(OH)_2$  precipitate acting as a flocculant and giving more consistent clarification.
- As an alternative, adopt a magnesium reduction goal to guide the lime feed. This may prove more difficult operationally because of the varying magnesium level in the raw water.
- SOC reduction is correlated with the magnesium reduction (see Thompson et al., JAWWA, June 1997, pp94-105), so the use of Mg as a control parameter may prove beneficial to the reduction in the TTHM potential and reduction in other DBP's.

### 3. Quality Control Issues

- If caustic alkalinity or magnesium are to be used in control decisions (as suggested above), it is important for the plant to institute some stringent quality control on those measurements. Both of these items involve the calculated difference between two titrated values. Thus, the chance for error is magnified if the two titrations are not performed with great care.
- A qualified individual should develop a quality control program for these parameters and instruct the operators in its importance and ensure that good practice is being followed.

### 4. Strategies During Low Alkalinity and Low Hardness in Source Water

- One option would be to run the four clarifiers in parallel for clarification without lime softening. Ferric and possibly a cationic polymer could be added at the intake, and coagulation would occur at a lower pH that would be more favorable for color removal. It would be necessary to raise the pH for corrosion control after clarification or following filtration. One disadvantage to this idea is the difficulty of switching from one mode to another as the source water changes fairly rapidly.
- Another option would be to add alkalinity to the source water so that softening reactions could continue in spite of low alkalinity and hardness in the source water. Alkalinity could be added using soda ash or lime plus  $CO_2$ . With either of these alternatives, the chemical(s) should be added to the mixing zone of the clarifier because precipitation of  $CaCO_3$  would result, and it would be desirable for deposition to occur on the sludge in the reactor mixing zone rather than in the piping between the units. If Mg is low in the source water, the Water Plant would not have the advantage of forming much flocculant  $Mg(OH)_2$  precipitate to aid in the flocculation of the fine  $CaCO_3$  precipitate. Therefore, the ferric coagulant would be essential to the process in this circumstance. The advantage of this alternative is that the transition into and out of this mode would be rather quick and easy.

## **D. USE OF POLYMERS IN TREATMENT**

Use of appropriate polymers is very common today. Cationics are common as partial substitutes for ferric or alum, serving as primary coagulants and are usually added at the same place in the flow scheme. Anionics are sometimes used as flocculant aids. Non-ionics are most commonly used for filter aids.

Use of polymers should be explored during troublesome treatment times using fresh polymer samples. The shelf life of polymer supplies recommended by the producer should be adhered to.

## **E. OPERATIONAL ISSUES**

### **1. Filter To Waste**

Currently, there is an uncertainty with the filter to waste flow rate. This will be addressed by installing a motor operated modulating valve on the 16-inch diameter filter to waste header, which will provide control of the filter to waste rate. The cost of this improvement is included in the cost analyses found in Chapter 8 for each of the alternatives.

### **2. Intake**

Currently, the existing intake is a concrete shore intake structure with a stationary steel bar barrier to prevent the larger debris and flotsam from being drawn into the two 20-inch diameter raw water pump station suction lines. However, the existing intake structure causes treatment problems due to the passage of fish and debris through the steel bar barrier and into the raw water pump station suction lines. This issue was evaluated by CTE and based on their recommendation, two new 20-inch diameter surface water intakes will be installed with welded wire intake screens, and the existing intake structure will be kept for emergency use only. The cost of this improvement is included in the cost analyses found in Chapter 8 for each of the alternatives.

### **3. SCADA System**

The existing Supervisory Control and Data Acquisition (SCADA) system is limited in its capabilities. Specifically, the current system is deficient in its ability to manipulate and archive data including the production of graphical displays. The trending of certain treatment parameters can only be produced using thermal strip chart plotters. The plotters present maintenance problems, and the thermal paper does not provide good data archiving. Therefore, based on evaluation and recommendations from CTE, improvements will be made to the SCADA System, which will include upgrading of the SCADA software and replacing the programmable logic controllers (PLC's) that will no longer be supported by the manufacturer due to obsolescence. The improvements will provide more meaningful data for better plant operations, as well as more information to regulators regarding treatment plant performance. The cost of the SCADA system improvements are included in the cost analyses found in Chapter 8 for each of the alternatives.